EXHIBIT IV

ENGINEERING ANALYSIS
IN A
PETITION FOR RECONSIDERATION
IN THE MATTER OF

AMENDMENT OF THE COMMISSION'S RULES
CONCERNING MARITIME COMMUNICATIONS
PR Docket No. 92-257
and
PETITION FOR RULE MAKING FILED BY
REGIONET WIRELESS LICENSE, LLC
RM-9664

Prepared by

Allen Davidson
July 17, 2002

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PROFESSIONAL BACKGROUND

Allen Davidson received his BSEE from the University of Illinois in Urbana Illinois in 1964 and his MSEE from Drexel University in Philadelphia, Pa. in 1970.

He started work in the field of antennas as a student at the University of Illinois Antenna Lab in 1962. He then spent 4 years at the RCA Broadcast TV Antenna Center in New Jersey and 3 1/2 years at Magnavox in Urbana Illinois working on specialized antennas before coming to Motorola in 1971.

He worked on communications antennas and radio systems at Motorola for 27 years, building the first MicroTAC Cellular portable radio antenna in the early 1970's. He spent several years establishing limitations on the use of adaptive antennas in the land mobile radio environment. One of his latest assignments was in Japan where he assisted in the writing of the standard for the new generation of digital mobile radios at 1.5 GHz and the field test that verified the performance of this new technology. Throughout this time, Mr. Davidson has done research into base, mobile, and portable land mobile antennas, multipath propagation, and system design in the terrestrial and mobile satellite services.

He is now semi-retired while continuing in the field of antennas and communications systems through Davidson Consulting Engineering, Inc. He is presently making long term (multi-year) UHF propagation measurements.

He has published 34 technical papers in the field of antennas and communications systems, and received the best paper of the year award for the VTS Transactions in 1975. He has been granted 17 United States patents.

He was elected to Pi Mu Epsilon, the honorary Mathematics fraternity and Sigma Tau, the honorary Engineering fraternity. He is a member of the IEEE APS and VTS, the TIA standards subcommittees TR-8.11 on Land Mobile Antennas and TR-8.8 on RF systems. He was elected to the Motorola Science Advisory Board Associates and was a Dan Noble Fellow (the highest technical award granted by Motorola)

EXECUTIVE SUMMARY

The FCC recognizes in the Second MO&O and Fifth R&O that "the primary purpose of these services [the maritime CMRS] is to provide for the safety of life and property at sea and on inland waterways." This is a characteristic that is specific to the AMTS band, yet the Commission concludes "that AMTS geographic licenses should adhere to the 10 dB co-channel interference standard." The Telecommunications Industry Association (TIA) has shown that 12 dB co-channel interference protection is "Understandable with considerable effort [with] frequent repetition due to Noise/Distortion." This is unacceptable performance for a service with the primary purpose stated by the Commission. TIA shows that 18 dB is required to provide "Speech understandable with slight effort. Occasional repetition [is] required due to Noise/Distortion." This is consistent with the stated primary purpose above.

Using the 10 dB co-channel protection and 38 dBu service contour adopted by the Commission, it is shown herein that a geographical licensee can locate a single station that will produce interference that will reduce the useful coverage of an incumbent to 70 percent of existing coverage. Multiple geographical licensed stations can reduce that to only 23 percent of existing useful coverage. It is also shown that a single geographical licensee can produce interference that will break the continuity of service established by an incumbent. This will force the incumbent to be in direct conflict with the Commission's requirement of geographic continuity of service in 47CFR § 80.475(a).

INTRODUCTION

Regarding CMRS, of which AMTS is one, the Commission has stated "the primary purpose of these services is to provide for the safety of life and property at sea and on inland waterways."[1] Yet, the Commission concludes "that AMTS geographic licenses should adhere to the 10 dB co-channel interference standard that is used in the adjacent 220-222 MHz band." The Telecommunications Industry Association (TIA) technical standards bulletin TSB-88A identifies the level of audio quality necessary for safety functions, and relates that to co-channel interference. This will be presented herein.

In addition, the AMTS stations automatically assign channels to marine stations within each operating area. Unlike VHF Maritime, an AMTS user does not monitor the status of the channel before transmitting. This is much more like the trunked systems in use in the 800 MHz band. Therefore, an equal or better quality of signal is required for stations in the AMTS band than for those in the VHF Maritime band. 18 dB co-channel protection will be shown herein to provide the quality of service required for AMTS users.

Also, the Commission has required that AMTS applicants "...provide continuity of service along more than 60% of each of one or more navigable inland waterways." And "AMTS applicants proposing to serve portions of the Atlantic, Pacific or Gulf of Mexico coastline must define a substantial navigational area and show how the proposed system will provide continuity of service for it."[2] AMTS systems that are operated by Mobex Network Services typically use tall antenna sites for the coast station. 1000 Watts ERP provides a large coverage area with acceptable voice quality and permits a minimum of coast stations to cover the continuous geographical area of interest. Fewer coast stations was recognized as an advantage when originally choosing the 217 MHz band for AMTS.[3] However, with a 38 dBμ coverage contour, incumbents will not be able to provide continuous coverage as required.

In this document, we will show that wide area coverage out to a contour bounded by 17 dBμ provides voice quality that is appropriate for AMTS service. Then we will show that reducing that contour to 38 dBμ and protection of that contour to only 10 dBμ can destroy the continuous coverage that has been required by the Commission of incumbent AMTS providers. This will happen when a geographic licensee places a co-channel station nearby that meets the FCC protection rule, but causes unacceptable interference to areas formerly within the 17 dBμ coverage area of the incumbent. Thus, the continuous coverage is destroyed and the purpose of the AMTS band violated.

[1] In paragraph 3 of the 2nd MO&O and 5th R&O in PR Docket No. 92-257 and RM-9664 adopted March 13, 2002 Released April 8, 2002.
[2] See CFR 47 § 80.475(a)
[3] FCC General Docket No. 80-1, RM-3128, RM-3128, and RM-3129 Report and Order adopted January 29, 1981, §64.

ANALYSIS OF CO-CHANNEL PROTECTION

In this section it will be shown in two ways that 10 dB of protection at the interference boundary of the incumbents is inadequate, and that 18 dB of protection as used in the VHF Private Land Mobile band as well as the 800 MHz and 900 MHz bands should be used.

Shared Users Experience

When shared users of a frequency are on a repeater, and need to communicate, the proper protocol is to monitor the frequency before using it. If it is in use, they are to wait until the communication is completed before initiating their own message. In this way, interference is avoided between the shared users.

As the operators become more familiar with each other, they learn the characteristics that allow more efficient use of that frequency. For instance, if an operator monitors and hears an unintelligible weak signal, it is probably on a different repeater, and out of range. Thus, it is appropriate to go ahead and transmit. Or if a stronger signal is received, and the operator knows that the other user is always close to another repeater, that operator can sometimes safely transmit. This occurs when the operator knows the other user will have a signal strong enough to retain capture of that users repeater in the presence of this operators weaker signal.

Computers continue to increase their capability, however they cannot match the comprehension ability of the human ear and brain as illustrated above. As in the bands above 800 MHz, the Mobex incumbent AMTS system relies on digital signaling for call setup. While 10 dB might be a satisfactory ratio of protection in the 220-222 MHz band, where many single channel stations are controlled, essentially, by the human ear and brain, an automated system in the 217 MHz band requires the same ratio of protection as an automated system above 800 MHz if it is to provide reliable service.

Audio Quality vs. C/(I+N), A Life Safety Issue

The commission agrees in the subject MO&O and R&O that "the primary purpose of these services is to provide for the safety of life and property at sea and on inland waterways." Thus, when there is an emergency, it is imperative that the intelligibility of the communication not be severely impaired.

The intelligibility of radio communications has been reported by the TIA in TSB-88A.[4] Delivered Audio Quality (DAQ) is the criterion used, and they state:

> The goal of DAQ is to determine what mean C/(I+N) is required to produce a subjective audio quality metric under Rayleigh multipath fading. The

[4] TSB-88A, published June 1999, pp. 23 TABLE 1 and pp. 105 TABLE A-1

reference is to FM analog audio SINAD equivalent intelligibility. That is a static analog measurement so the Table 1 description has been provided to provide a cross-reference.

The audio quality criterion identified as DAQ is independent of the frequency band. The only qualification on that criterion is that the radio signal experience Rayleigh multipath fading. Recent books on land mobile radio agree that there is the same Rayleigh fading in land mobile signals from VHF (30 MHz) to UHF (3,000 MHz) and on up to 11,200 MHz in the SHF band.[5]

C/(I+N) as used in TSB-88A is defined as "Faded Carrier to Interference plus Noise ratio"[6] and does not permit a different percent of time or geographic coverage of the Carrier or Interference. A portion of their Table 1 is reproduced herein as Table 1 in this document. In it we see that a DAQ of 2 is associated with a SINAD of 12 dB and requires frequent repetition for the message to be understood. A DAQ of 3 (SINAD of 17 dB) requires occasional repetition, and a DAQ of 3.4 (20 dB SINAD) only rarely requires any repetition. A DAQ of 3.4 is recommended in TSB-88A for public safety services such as Police, Fire, and EMS, for instance. In these services, there is an ever present potential for a life safety situation requiring the need to communicate quickly. A DAQ of 3 is recommended for non public safety services.

TABLE 1
DAQ With Rayleigh Faded Signal Related to SINAD

DAQ Delivered Audio Quality	Subjective Performance Description	SINAD Equivalent Intelligibility
2	Understandable with considerable effort. Frequent repetition due to Noise/Distortion.	12 +/- 4 dB
3	Speech understandable with slight effort. Occasional repetition required due to Noise/Distortion.	17 +/-5 dB
3.4	Speech understandable with repetition only rarely required. Some Noise/distortion.	20 +/- 5 dB

[5] William C. Jakes Jr., MICROWAVE MOBILE COMMUNICATIONS, 1974, pp. 13; R.C.V. Macario, PERSONAL & MOBILE RADIO SYSTEMS, 1991, pp. 20-25; Kazimierz Siwiak, RADIOWAVE PROPAGATION AND ANTENNAS FOR PERSONAL COMMUNICATIONS 1995, pp. 149-155.
[6] TSB-88A pp.11.

The primary purpose of the AMTS is "to provide for the safety of life and property at sea and on inland waterways" as noted above. Thus, we conclude that a DAQ of 3 is adequate for AMTS.

A table in TSB-88A Annex 1 is provided to show the C/(I+N) that relates specific vendors equipment to the DAQ. Analog FM with 2.5 kHz deviation and 12.5 kHz channel spacing is shown in their Table 1 to require a C/(I+N) of 23 dB to provide a DAQ of 3. This analog equipment is in use in the AMTS band. However, the worst of the digital equipment designed for 12.5 kHz operation in that table provide a DAQ of 3 when operating in an environment with a C/(I+N) of 17 dB. It is assumed that the AMTS band will migrate to digital equipment as the 800 MHz band has and is doing, and therefore co-channel protection of 18 dB is indicated.

Thus an analysis has been presented that shows that 18 dB of protection is appropriate for AMTS.

ANALYSIS OF CONTINUITY OF SERVICE

Many of the AMTS systems that are operated by Mobex Network Services along the continental west coast range in height between 610 and 2440 meters (2000 to 8000 feet) above sea level. The low sites along this shoreline are at an elevation of about 185 meters (600 feet). Along the continental east coast the low sites are at elevations of about 100 meters (330 feet), and they range up to elevations of 450 to 900 meters (1475 to 2950 feet). Within the continental U.S.A., the river system sites in the plains are generally at elevations some 100 meters (330 feet) above the waterway, but the sites on tall buildings along the great lakes range up to 450 meters (1475 feet).

First we will show that a field strength of 17 dBμ for the AMTS incumbents is adequate for a DAQ of 3 as described above. Then we will show that significant interference will occur, and that the continuity of the incumbents AMTS service can be destroyed by the introduction of one or more coast stations by a geographic licensee that meet the requirements of the Commission as they now stand.

Signal Strength Requirement

The ship stations in the AMTS service use receivers that normally have a reference signal input specification that is equal or better than 0.5 μV (-113 dBm received power) at 12 dB SINAD. This is also the reference DAQ of 2 from above. There is a coaxial cable of 1.5 dB or less, and the antenna used depends upon the size of the vessel. Larger ships use antennas with up to 5.25 dBd of gain. Smaller ships, use 3 dBd and 0 dBd gain antennas. In addition to the structural limitations on what antenna is used, there is the communications requirement that the antenna beam remain pointing approximately horizontal. This is particularly important in rough seas where the pitch and roll may be severe, and when there may be a life safety emergency requiring communications. We

[7] as stated in § 48 of the 2nd MO&O and 5th R&O in PR Docket No. 92-257 and RM-9664 adopted March 13, 2002 Released April 8, 2002

will use a 5.3 dBd antenna with half power beamwidth of 20 degrees[8] in this analysis. This is appropriate since larger more stable ships regularly go farther from shore than smaller ones, and hence set the outer bounds of needed coverage.

The relation between the field strength, $E_{dB\mu}$, impinging on a dipole antenna, matched to 50 ohms, and the power, P_{dBm}, delivered to the coaxial cable is given by Hess as:[9]

$$P_{dBm} = E_{dB\mu} - 75 - 20\log(F_{MHz})$$

where F_{MHz} is the frequency in MHz. Using this equation and the information above, the power delivered to the receiver can be summed when the Field Strength at the Marine station is 17 dBµ as shown in Table 2.

TABLE 2
Computed Received Power from 17 dBµ
At the Marine Station Receiver

ITEM	VALUE
Received Field Strength	17.0 dBµ
Conversion to Power in dBm at 217 MHz	-121.7 dBm
Antenna Gain	5.3 dBd
Coax Loss	-1.5 dB
TOTAL	-100.0 dBm

There is 13 dB of signal above the –113 dBm required to produce the reference 12dB SINAD with its DAQ of 2. 5 dB of that 13 dB is necessary to increase the SINAD to 17 dB that was shown in TABLE 1 above to be associated with an acceptable DAQ of 3. The additional margin allows for more time variation in propagation from that used in the F(50,50) R-6602 Field Strength[10] used for the computation here.

The inbound signal is found in a similar manner except a longer or horizontally directional antenna can be used at the coastal station, so the gain of the antenna used at

[8] The 20 degree half power beamwidth here is the angular difference in the points on the vertical pattern of the antenna where the radiated power is only one half of that which is radiated on the maximum of the pattern.

[9] Garry Hess, *Land Mobile Radio System Engineering*, Artech House, Boston, 1993, pp. 12.

[10] Jack Damelin, William A. Daniel, Harry Fine, and George Waldo, DEVELOPMENT OF VHF AND UHF PROPAGATION CURVES FOR TV AND FM BROADCASTING, FCC Report No. R-6602, September 7, 1966.

that location is 12 dBd.[11] Additional preamplification can be used in the receiver to bring the received signal 12 dB SINAD sensitivity down to 0.3 μV (-117 dBm received power). There will also be an assumed 3 dB of coaxial cable attenuation and a duplexer also with 3 dB of loss. A 25 Watt transmitter (16 dB below 1 kW = 0 dBk) will be assumed at the marine station with the 5.3 dBd antenna and 1.5 dB coaxial cable loss used previously. These produce an ERP at the marine station of 0-16-1.5+5.3 = –12.3 dBk instead of the 0 dBk assumed for the outbound link. That will reduce the received signal strength at the coastal station from 17 dBμ to 17-12.3=4.7 dBμ. The inbound computation is shown in TABLE 3.

TABLE 3
Computed Received Power from 7.7 dBμ
At the Coastal Station Receiver

ITEM	VALUE
Received Field Strength	4.7 dBμ
Conversion to Power in dBm at 217 MHz	-121.7 dBm
Antenna Gain	12.0 dBd
Coax Loss	-3.0 dB
Duplexer Loss	-3.0 dB
TOTAL	-111.0 dBm

This too has margin over the 12 dB SINAD sensitivity of the receiver by a total of 117-111=6 dB. Thus, this link also has enough margin to meet the acceptable DAQ of 3 in TSB-88A.

EFFECT OF INTERFERENCE

It has been shown that 17 dBμ provides acceptable coverage for existing users of the AMTS band. Now, the effect of a properly operating geographical licensee on the area of service of an incumbent will be shown. First, a theoretical analysis will be completed, and then a real world installation will be analyzed.

[11] The DB PRODUCTS catalog no. 25 copyright 1996 pp. 25 shows the DB268 antenna that meets this requirement.

THEORETICAL ANALYSIS

It was mentioned earlier that tall sites with elevations in excess of 305 meters (1000 feet) are used by Mobex, and we will use this height with 1 kW ERP for the incumbent station. It was shown above that this provides acceptable performance at a 17 dBμ contour whose range will now be determined. The Commission has used 1 kW at an elevation of 61 meters (200 feet) as reference parameters, and that will be used for the geographical licensee station. The geographical licensee can locate the station at a distance of 193 km (120 miles) from the incumbent and meet the requirement for 10 dB protection as required by the FCC in the Second MO&O and Fifth R&O. This is shown in the computed field strength vs. distance curves (obtained using report R-6602) in Figure 1. Here the signal strengths each are shown as they would be independently detected with a receiver placed near the incumbent station, and then moved directly toward the geographically licensed station.

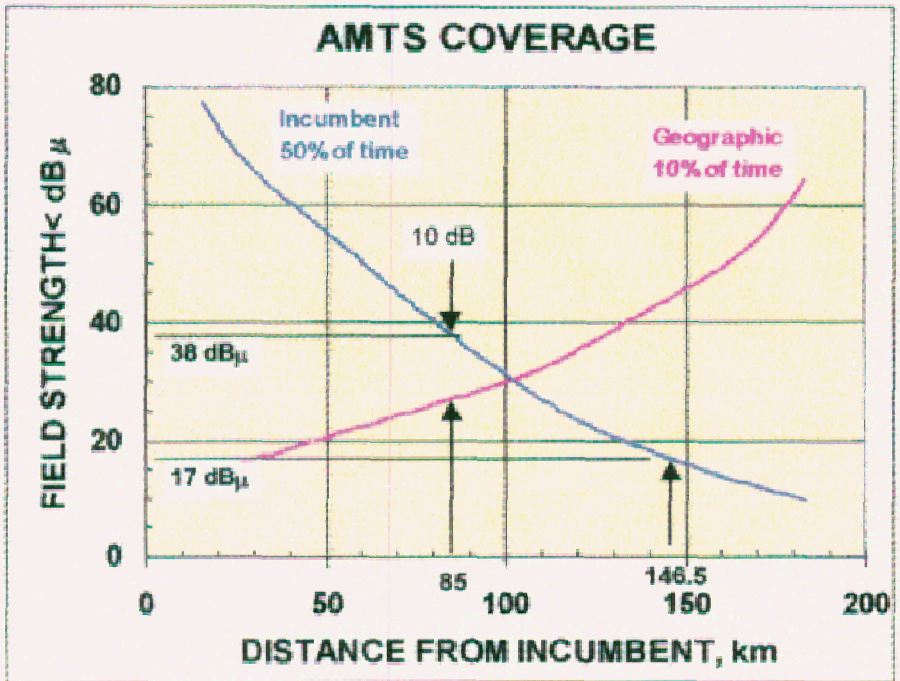

Figure 1 Computed field strength for a 1 kW ERP incumbent 305 m AAT located at the origin, and a 1 kW ERP geographic licensee 61 m AAT located at 193 km.

The 17 dBμ field strength of the incumbent occurs 146.5 km from the coastal station, but the 38 dBμ field strength of the incumbent, with 10 dB protection from the geographical licensee, occurs only 85 km from the incumbent station. So much of the coverage from this incumbent coastal station will be lost. This is a one dimensional representation, but more is to be seen from a detailed two dimensional representation as shown in Figure 2.

Here, data from Figure 1 has been used to present the area of coverage and interference in the form of a geographical plot. The vertical scale measures km north and the horizontal scale measures km east. The coastal station of the incumbent is located at the origin (zero on the horizontal axis), and the base station of the geographical licensee is 193 km (120 miles) above that. The 17 dBμ contour and 38 dBμ contour that were each just a single point in Figure 1 above are shown as circles encompassing large areas. With no interference present, or with interference protection limited to 18 dB at the 17 dBμ contour, the incumbent has the total coverage area within the circle, almost 67,400 sq. km.

But, an additional contour is shown which maintains the C/I of 10 dB while going (left to right) from the incumbent 17 dBμ contour to the 38 dBμ contour then back out to the 17 dBμ contour. This is a computer generated contour using the R-6602 propagation curves while maintaining the ratio of the incumbent's F(50,50) field strength to the geographical licensees F(50,10 field strength at 10 dB. The area between the 10 dB C/I contour and the 17 dBμ contour has been filled in indicating that the interference here is worse than 10 dB C/I. With this interference present, the protected coverage area of the incumbent is reduced by about 15,400 sq km from the original area, leaving protected only 77 percent of the original area.

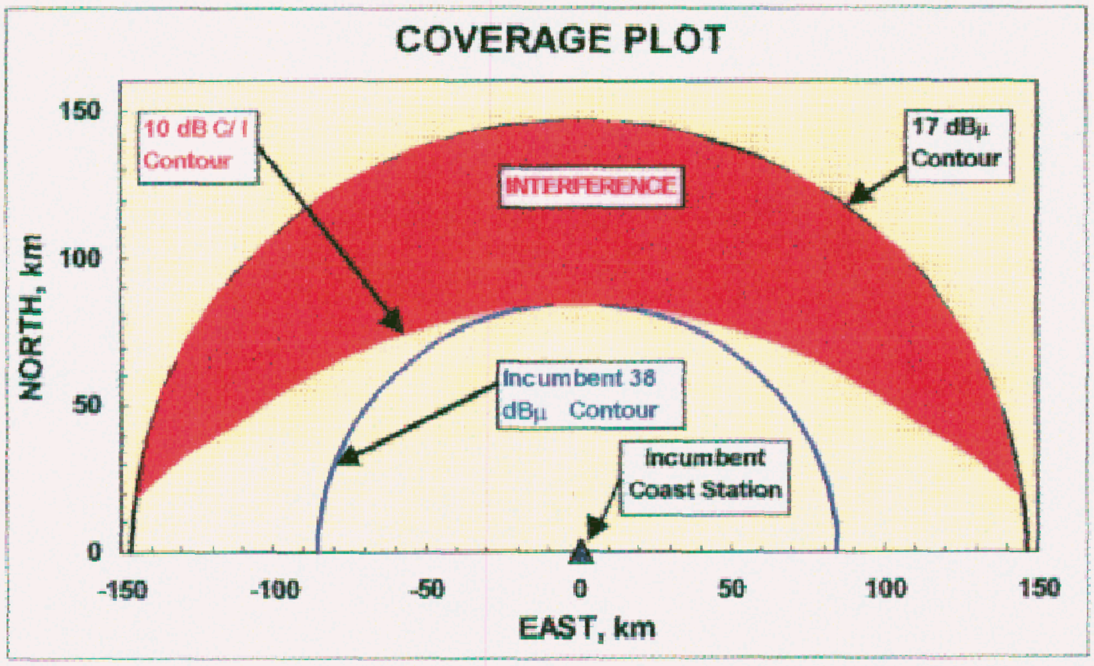

Figure 2 Computed coverage and interference to an incumbent AMTS system with and without interference from a geographic licensee meeting the required FCC 10 dB protection criterion.

Another geographical coverage plot has been produced that reduces that interference to the incumbent as shown in Figure 3. The same 1 kW ERP at a height of 305 meters (1000 feet) has been used for the incumbent licensed station. Also 1 kW ERP at a height of 61 meters has again been used for the geographical licensee. However, the protected coverage contour of the incumbent has been decreased to 28 dBμ and the C/I protection ratio increased to 18 dB at that location. In order to accomplish this, the separation of the geographical licensee from the incumbent was increased to 313 meters (195 miles).

The same 17 dBμ contour is shown, covering a total area of 67,400 sq. km. But the 28 dBμ contour provides a greater protected coverage area than did the 38 dBμ contour in Figure 2. The total filled in area that will experience interference greater than 18 dB C/I in this case is 7,700 sq. km leaving 89 percent of the area that will provide acceptable coverage as shown above.

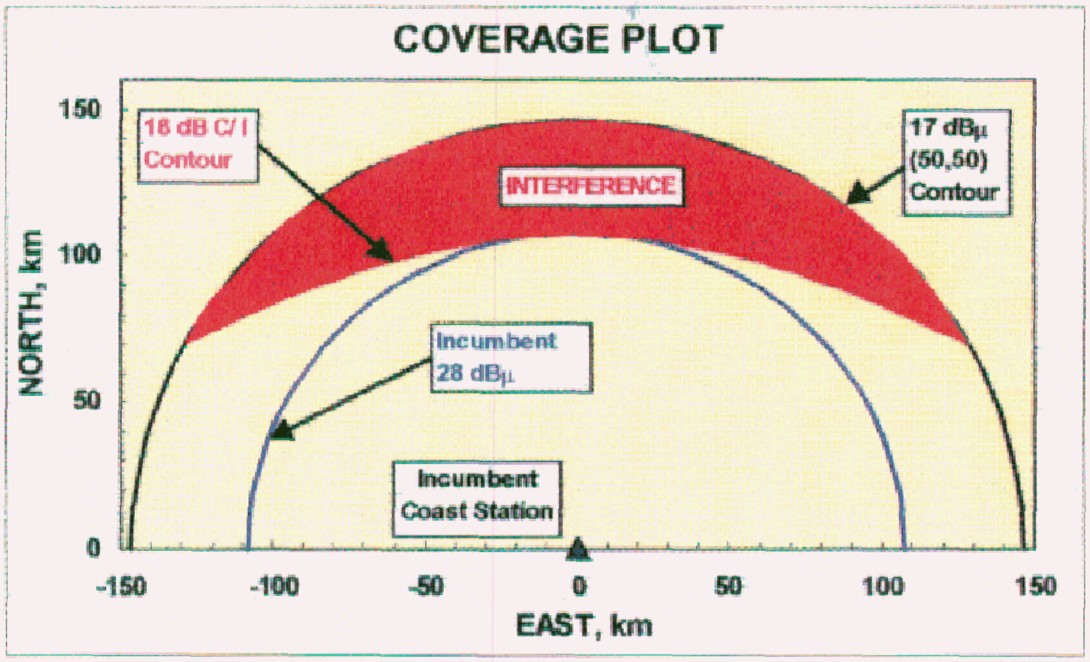

Figure 3 Computed coverage and interference to an incumbent AMTS system with interference from a geographic licensee meeting a protection requirement of 18 dB at a protected contour of 28 dBμ.

CONTINUITY OF SERVICE

It has been shown that 17 dBμ provides acceptable coverage for existing users of the AMTS band. Now, the effect of a properly operating geographical licensee on the FCC required continuity of service of AMTS along the coast will be shown.

Figure 4 is a schematic showing the 17 dBμ contour of coverage of 3 AMTS incumbent coast stations that provide wide area coverage from tall sites, at locations L1 through L3, along a shore line. They use overlapping coverage and each site is licensed for all frequencies in the same block. Dynamic assignment of frequencies is used to provide coverage where needed, though the same frequency is never used at adjacent incumbent locations. The 38 dBμ contours of the stations at L1 and L2 are also indicated.

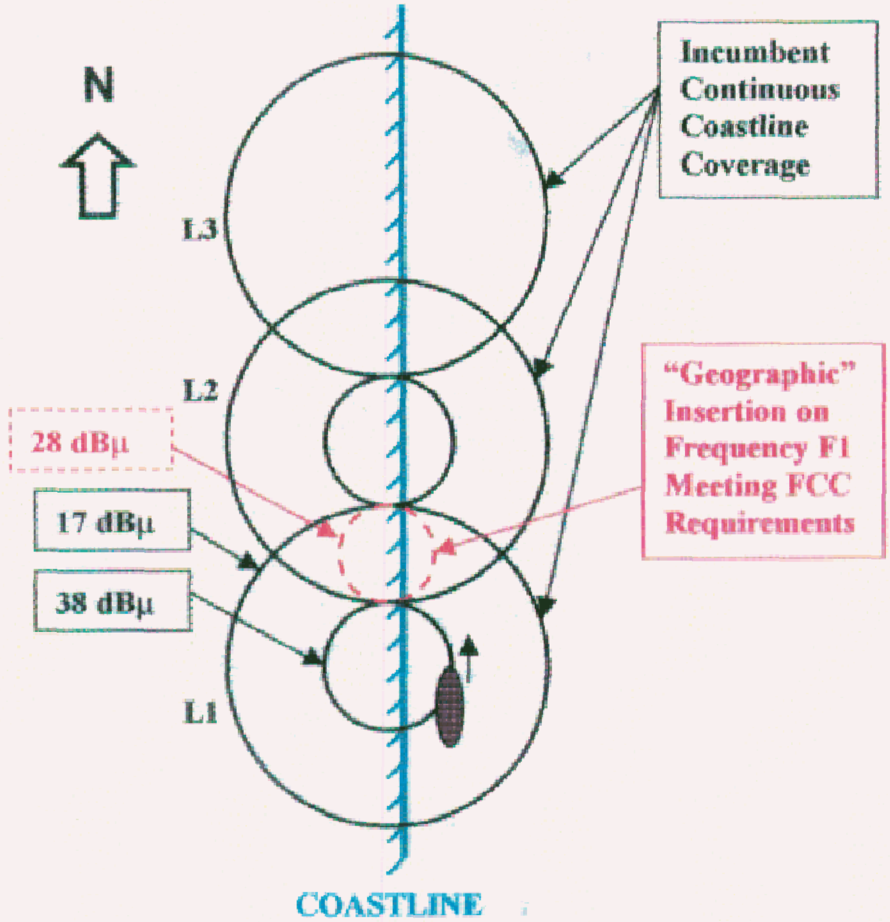

Figure 4 Pictorial representation showing continuous coverage of three incumbent licensed coastal Stations with one co-channel geographical licensee.

A ship is also indicated proceeding north through the coverage area of L1. In addition, there is a single station from a geographical licensee that is shown in the figure with its 27 dBμ contour just touching the 38 dBμ contour of the nearby incumbent stations. This geographical licensee meets the requirement of the FCC by providing a protection of 10 dB to the incumbent at both of the incumbent's 38 dBμ contours, so that station can operate on all of the licensed frequencies of the incumbent.

The field strength data from Figure 1 has been used to determine the area of coverage and interference that is presented in the form of a geographical plot in Figure 5. Again, the vertical scale measures km north and the horizontal scale measures km east. The coastal stations are located along the vertical axis, and it is assumed that there is a large body of water to the east of these stations. The contours for the incumbent stations are computed from those parameters presented above. But the location of the interfering geographical station is mid way between the incumbent stations 117.5 km from the origin. This is much closer to the incumbent than was the case previously shown. Of course, the ERP must be scaled down and at this spacing the reduction in power is –24.2 dB from 1 kW. This is low for a station that would be used for wide area coverage, but may be just right for a fill in station.

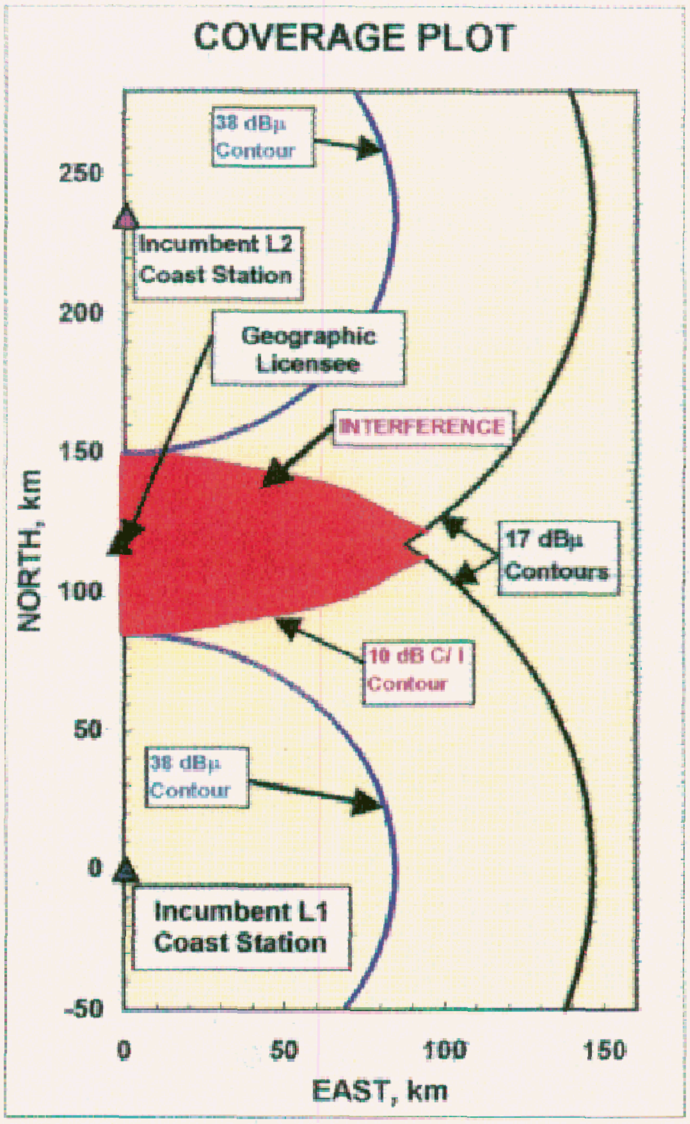

Figure 5 Computed coverage and interference to an incumbent AMTS system with and without interference from a geographic licensee meeting the required FCC 10 dB protection criterion.

The coverage of the incumbent system, without the geographical licensee present, extends from the shore to a range not less than 88 km from the "shoreline" where the 17 dBμ contours of the coastal stations of the incumbent intersect. And it is continuous along that area from below the coastal station at L1 to above the coastal station at L3 meeting the FCC requirement for continuity of service in 47CFR § 80.475(a) along this 280 km of "shoreline".

However, with the geographical licensee present a, 10 dB interference contour for the station at L1 starts with a ratio of 38 dBμ to 28 dBμ for the L1 incumbent to geographical licensee's respectively at the "shoreline" about 85 km from the origin. The ratio of 10 dB is constant until it ends with a ratio of 17 dBμ to 7 dBμ at the outer coverage contour of the L1 incumbent, out in the ocean almost due east of the geographical station. The interference contour for the incumbent station at L2 likewise starts at about 150 km from the origin and proceeds out to its 17 dBμ contour. The area between these contours has been filled in indicating that there will be interference to all incumbent users here when the geographical user is in operation.

So, when an AMTS user on the incumbent system of L1 arrives at that area, there will be unacceptable interference whenever the geographical licensee is transmitting on the same frequency, and that interference will be present until this area is crossed. The interference is present over an area bounded by the two short 17 dBμ contours of the incumbent, the two 10 dB C/I two interference contours, and the 64.6 km segment along the shoreline. Thus the interference reaches from the shoreline out to the contour of the incumbent system. Note, by symmetry the coverage to any land mobile users of the AMTS incumbent to the west will also be impacted negatively.

Worse yet, the rules will permit the geographical licensee to locate such a station between each of the wide spaced incumbent stations, thus breaking the incumbent coverage into relatively short non-continuous segments of 170.4 km coverage separated by 64.6 km segments of interference. Thus, the incumbent will not be able to meet the requirement of the Commission in 47CFR § 80.475(a) to provide continuity of service along such a shoreline.

PRACTICAL IMPLEMENTATION

The forgoing was developed on the basis of a theoretical flat model. However, when a real installation is considered, practical details must come under consideration. We will consider here the installation of two geographical licensed stations interspaced between three existing licensed and functioning coastal stations The three licensed Mobex facilities are listed in TABLE 4.

TABLE 4
Existing Mobex Installations

LOCATION	LATITUDE	LONGITUDE	GND. ELEV.	ANT. HT.
Bull Run, VA	38-54-23	77-40-23	312.4 m	36.8 m
Richmond, VA	37-36-52	77-30-56	77.7 m	61.0 m

Soffolk, VA	36-49-00	76-28-05	8.0 m	53.0 m

First, we will consider the computed coverage of these stations with their full licensed power of 1.0 kW ERP. That coverage has been computed by determining the HAAT of radials every 10 degrees from USGS map data. The R-6602 algorithm described before was then used with the HAAT in each direction to determine the field strength, adjusted by 9 dB for the elevation of a land mobile unit, to determine the range out to the 38, 28, and 17 dBμ contours. The F(50,50) curves were used for this analysis, and the results were then plotted on a map of the area that is shown in Figure 6. The outer curve in each case is the 17 dBμ contour with the larger field strength moving progressively inward. It is noted that these contours are not circles, though they are somewhat circular in shape. This is the result of the HAAT being greater in some directions than others.

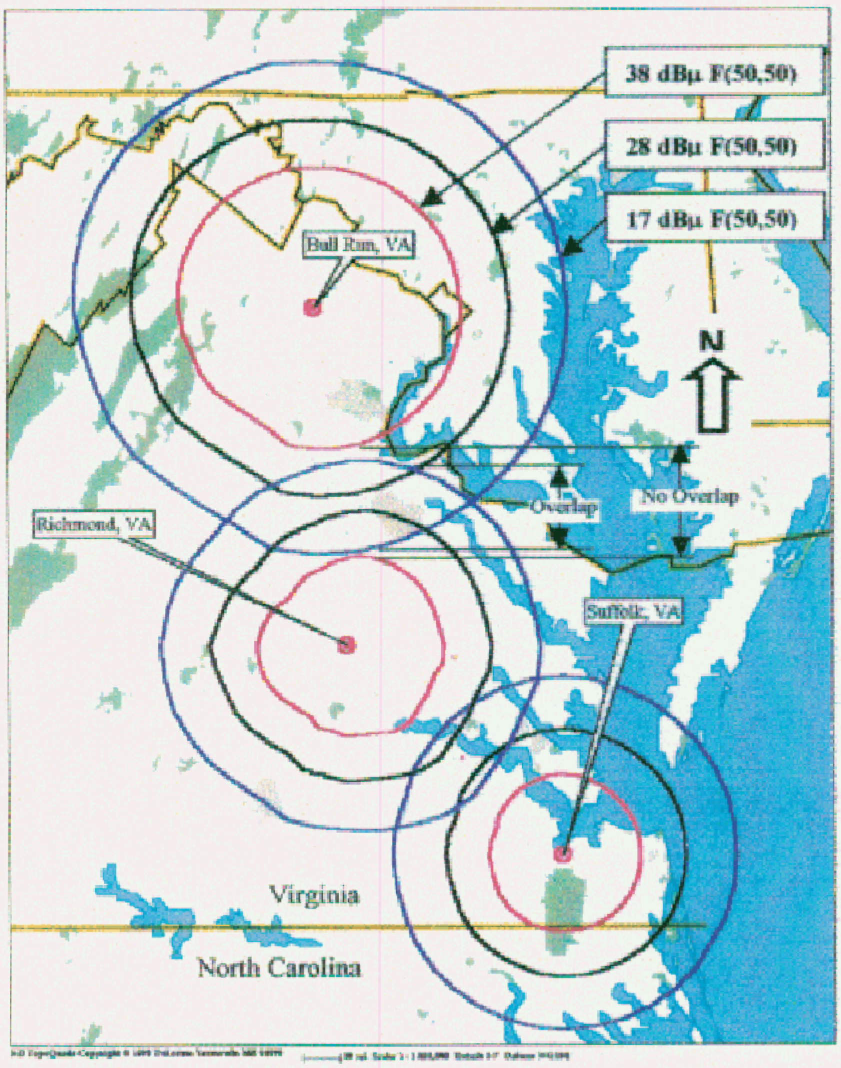

Figure 6 Geographical coverage contours of three licensed Mobex AMTS stations along the Virginia coast.

The coverage of the 17 dBμ contours overlap, but the other two levels do not overlap. It is evident that there are relatively wide gaps between the 38 dBu contours, some 33.9 km between the north pair (as indicated on Figure 6) and 47.6 km between the south pair. In the instant MO&O the FCC allows for geographical licensed stations to locate there if the applicant can show that they will "provide 10 dB protection to the incumbent's predicted 38 dBμ contour.[12] We will now show that this spacing is more than adequate to allow a geographical licensed station to be placed between each of the two overlapping sets of contours, thus breaking the continuous coverage that they can now provide.

In our previous analysis we used an omnidirectional antenna to show that coverage could be broken. But, in the real world, a licensee will want to provide as much coverage as possible. Thus, it is likely that a geographical licensee will use a directional antenna that will provide maximum signal in the direction away from the incumbent's 38 dBμ contour. It will also maintain a maximum of 28 dBμ of signal (using the F(50,10) field strength curves) as close as possible along that nearby incumbent's contour.

A simple three antenna array can provide such protection while maximizing coverage in the direction away from the contour(s). Three conventional omnidirectional antennas (in the horizontal plane) spaced one half wavelength apart on a straight line, and fed in phase with unequal power produce a two lobe pattern. The feed network divides the power so the two outside radiators of the array each receive a signal 7.18 dB below the center radiator.[13] The computed pattern for that array is shown in Figure 7. Two maximums radiate broadside to the array, and two minimums are located in the direction off the ends; multiple low level sidelobes are inherently suppressed in this design. The minimums between the beams are 20 dB down, and that magnitude of minimum is relatively easy to construct and maintain over the AMTS band. Thereby, a geographical licensee can disrupt a substantial amount of an incumbent's existing coverage while meeting the letter of the commission's rules.

[12] See paragraph 31.

[13] The relative currents are 1.0 for the center antenna and 0.406 for the side antennas.

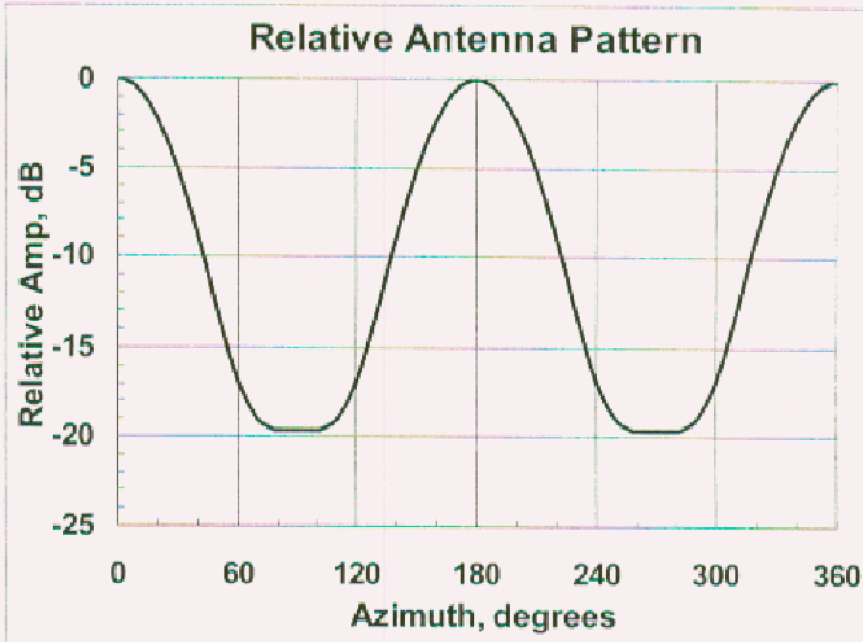

Figure 7 Antenna pattern used for the geographical licensed sites.

The geographically licensed stations are located approximately midway on a line between the adjacent incumbent stations. Realistically, they are each located on a nearby hill that had existing roadways for access. The coordinates for the north site are N 38-09-18.2 and W 77-30-19.6 and for the south site they are N 37-11-09.5 and W 76-57-22.6. There were no nearby dwellings on the USGS maps that were consulted, and the Delorme mapping software[14] indicated that the area was mixed forest woodland. The assumed elevation of the antennas was 61 meters (200 feet) above ground level.

The HAAT in the direction of the incumbents 38 dBμ contours from the sites were determined; there were several more additional radials than normal used to assure that the computation is valid. The antenna patterns were oriented to optimize the protection of the incumbents, so the main beams pointed at a bearing of 90 and 46 degrees for the north and south sites respectively. The ERP was adjusted to the 1 kW maximum allowed which provided for 28 dBμ of signal with the F(50,10) curves at or outside the incumbent's 38 dB contour, and this resulted in a transmitter power less than 50 watts. The result achieved is shown in Figure 8.

[14] 3-D TopoQuads, Copyright 1999, Delorme, Yarmouth, ME

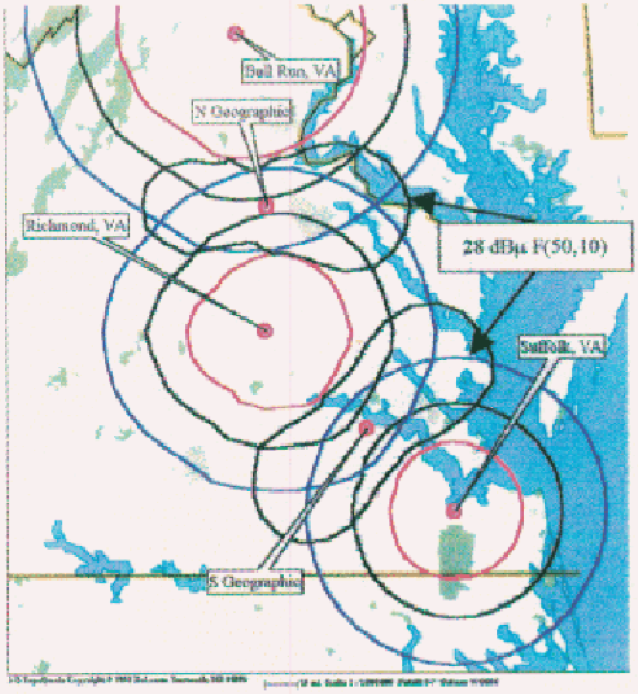

Figure 8 The F(50,10) 28 dBμ contours of two geographical licensed coastal stations break the incumbent's continuous coverage.

The 28 dBμ contour used to protect the geographical licensee cleaves the coverage of the three incumbent sites into three separate geographical areas. There is some limited coverage that is available to the geographical licensee, and the F(50,50) 38 dBμ contour has been produced for the geographical sites as shown in Figure 9.

The bearing to the North Geographic station is 0.8 degrees from the Richmond site, and the South Geographic station bearing is 133.9 degrees. There is much open area to the west by southwest of the Richmond site. It may be desirable for a geographical licensee to have coverage in that direction. One site located at a bearing of about 247.3 degrees would allow the maximum flexibility for that site, and such would add to the interference impact on the Richmond incumbent coverage. However, that will not be developed here.

The coverage shape of these sites is approximately an ellipse, and for the North and South sites respectively their major axes are 61 and 41 km and the minor axes are 20 and 26 km. Development of the coverage of these stations is not the subject of this report, so it will not be pursued further.

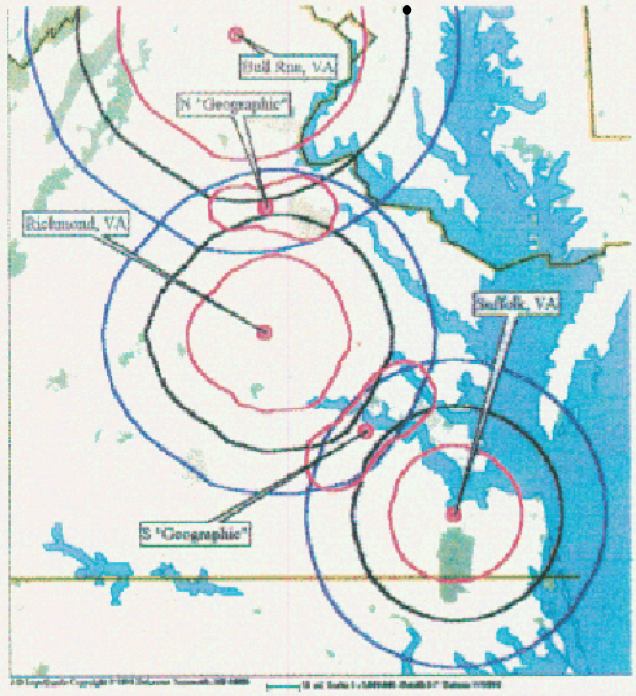

Figure 9 F(50,50) 38 dBu coverage contour of the geographical licensees is shown on the contours of the incumbents

Mobex AMTS users report that they have acceptable communications out to the 17 dBμ contour. Therefore, we will determine the area lost from the 17 dBμ contours of the three incumbent stations. Four contours were produced at the location of the 10 dB C/I protection of the Mobex signals.[15] They have been superimposed on the map that was shown in Figure 8. An area is formed that is bounded by the 17 dBμ signal strength contours and those 10 dB C/I contours. That area is the coverage lost by the incumbent licensee, and it is shown in Figure 10.

The percent of area inside the 17 dBμ contour that is lost has been computed using numerical integration. The area bounded by the individual interference contours due to both the North and South Geographical licensed stations have each been determined. In addition, the area within the 38 and 28 dBμ contours have also been computed. The results are shown in Table 5.

[15] These C/I contours start at the incumbent 17 dBμ F(50,50) contour, where the interference has an F(50,10) signal strength of 7 dBμ, and proceed inward to the incumbent 38 dBμ F(50,50) contour where the interference has an F(50,10) signal strength of 28 dBμ. It then proceeds back outward to the other side of the of the 17 dBμ F(50,50) contour where the interference again has an F(50,10) signal strength of 7 dBμ.

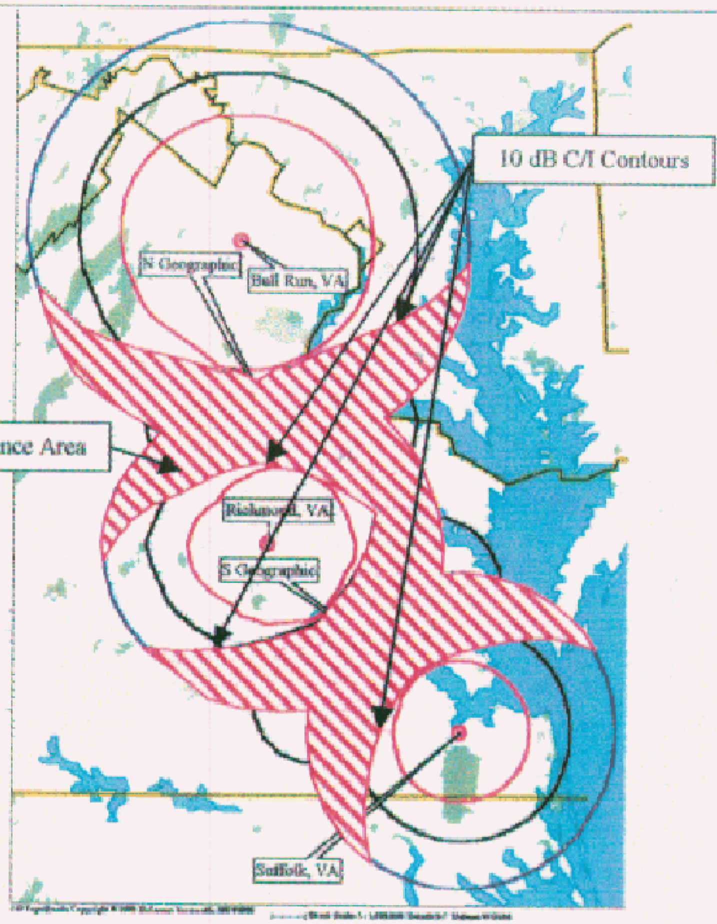

Figure 10 Constant C/I contours are shown, and the area of interference of the geographical licensee is also indicated.

TABLE 5
Percent of Area Lost Due To Interference
As Percent of Area in 17 dBµ Contour

INCUMBENT CONTOUR	38 dBµ CONTOUR	28 dBµ CONTOUR	NORTH GEOGRAPHIC	SOUTH GEOGRAPHIC
Bull Run	67.3 %	40.3 %	19.6 %	N.A.
Richmond	77.1 %	47.6 %	28.8 %	30.0 %
Soffolk	80.3 %	51.2 %	N.A.	30.1 %

The worst case for each incumbent site occurs when only the coverage within the 38 dBµ contour is considered to remain viable. We have considered only two geographical licensed stations in the analysis above, but it was mentioned that a third geographical licensed site could be added adjacent to the Richmond site. Additional sites could be added around the other incumbent sites also, and in the limit, only the area within the 38 dBμ contours would be left. Thus we see the potential impact is to reduce the area covered to about one third to one fifth of that at the present time.

The areas bounded by the 17 dBμ and 10 dB C/I contours represent between 20 to 30 percent of the existing coverage area of each individual incumbent site. It should be noted, that there is overlap of the two interference areas within the Richmond coverage area. Thus, the two cannot be directly summed to determine the total area shown on Figure 10.

Of more importance is the fact that they remove all possibility of continuous coverage between the three incumbent stations. This fact is very important because this is a real world example that contradicts a requirement of the FCC for AMTS applicants in 47CFR § 80.475(a). Specifically that requirement is that "AMTS applicants proposing to serve portions of the Atlantic, Pacific or Gulf of Mexico coastline must define a substantial navigational area and show how the proposed system will provide continuity of service for it." It will be impossible to maintain that continuity of service.

We also include in the analysis the percent of the original coverage area produced by a 28 dBμ contour. This contour encompasses coverage of about half of the original area in each case. Here is the impact on a potential geographical licensed site being placed between the incumbents is important. The width between the 28 dB contours at the North and South sites respectively is 7.6 km and 16.0 km, with about half on each side. This is significantly less than the 33.9 and 47.6 km between the 38 dBμ contours reported above. If an 18 dB protection contour were required, as shown necessary by the TIA in the analysis above, an estimate can be made of the 38 dBμ coverage possible.

The R-6602 curves, with HAAT as defined, are not directly applicable because the range of interest is always half or less than the 16 km range over which the HAAT is determined. Not withstanding, they will be used for the estimate. The ERP to produce 28-18=10 dBμ (adjusted by 9 dB for receiving antenna height) at the incumbent 28 dBμ coverage contour is determined first. For the South site, an ERP of 5 mW is required. Then, with that ERP, the 38 dBμ coverage range is 2.8 km. For the north site 0.15 mW ERP and 1.1 km respectively are obtained. Such coverage range may be appropriate for micro or pico-cellular sites, but for AMTS, coverage it would be prohibitively expensive.

CONCLUSION

The Commission has accepted a requirement for AMTS geographic licenses to adhere to a 10 dB co-channel interference standard at a coverage contour of 38 dBμ. It has been shown herein that co-channel interference protection of 12 dB, 2 dB more, is "Understandable with considerable effort [with] frequent repetition due to Noise/Distortion." This is inconsistent with the stated primary purpose of AMTS "to provide for the safety of life and property at sea and on inland waterways." It has also been shown that the computer controlled assignment of channels in the AMTS requires more co-channel interference protection than human controlled channel access of the 220-222 MHz band. It is more consistent with the computer controlled assignment in the 800 MHz band. Thus, it is recommended that a co-channel interference standard of 18 dB be implemented.

It has also been shown that the 10 dB co-channel interference standard implemented at a coverage contour of 38 dBμ can reduce the acceptable coverage area of an incumbent AMTS by up to 80 percent of the coverage area that is presently available from a tall site. That leaves a coverage are of only 20 percent. This will occur if a geographical licensee just meets the requirements at the boundary of a continuous AMTS that uses high locations to provide wide area coverage.

Finally it has been shown that the FCC rules, as issued with 10 dB of protection at the incumbents 38 dBu contour, will allow a geographical licensee to locate transmitter sites that will provide moderate sized coverage footprint near the incumbent. However, the presence of the geographical licensee will break the continuous coverage of the incumbent as required by 47CFR § 80.475(a).

EXHIBIT V

PUBLIC NOTICE

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WIRELESS TELECOMMUNICATIONS BUREAU ACCEPTS AND APPROVES CONSENSUS ANALYTICAL METHOD FOR DETERMINING ADDITIONAL FREQUENCY COORDINATION REQUIREMENTS FOR CERTAIN PRIVATE LAND MOBILE 150-470 MHz APPLICATIONS

By this *Public Notice*, the Wireless Telecommunications Bureau (Bureau) accepts and approves the consensus analytical method for determining whether Private Land Mobile Radio (PLMR) applications "trigger" the additional frequency coordination requirements of Sections 90.35(b)(2)(iii) and 90.175(b) of the Commission's Rules.[1] This consensus analytical method was recommended by the Commission's certified frequency advisory committees ("FACs" or "coordinators") for PLMR spectrum.

By way of background, applications for new or modified facilities on frequencies below 512 MHz shared by the former Power, Petroleum, Railroad, Manufacturers, Forest Products, Telephone Maintenance, Motor Carrier and/or Automobile Emergency Radio Services prior to the Commission's consolidation of such services into a single Industrial/Business (I/B) Pool may be coordinated by any FCC-certified I/B Pool coordinator.[2] However, if the interference contour of a proposed station (19 dBu contour and 21 dBu contour for VHF and UHF, respectively) would overlap the service contour of an existing station licensed on one of these previously shared frequencies (37 dBu contour and 39 dBu contour for VHF and UHF, respectively), the written concurrence of the coordinator associated with the industry for which the existing station license was issued, or the written concurrence of the licensee of the existing station, must be obtained.[3] The coordinators' engineering studies are not filed with the Commission unless specifically requested by the Commission's staff.

[1] 47 C.F.R. §§ 90.35(b)(2)(iii), 90.175(b) (2002). *See also 1998 Biennial Regulatory Review – 47 C.F.R. Part 90 - Private Land Mobile Radio Services, WT Docket No. 98-182, Memorandum Opinion and Order and Second Report and Order,* FCC 02-139 ¶ 46 (rel. May 23, 2002).

[2] *See id. See also* Letter from Robert M. Gurss, Esq., President, Land Mobile Communications Council, to Thomas J. Sugrue, Esq., Chief, Wireless Telecommunications Bureau, FCC, dated June 26, 2001, at 2 (LMCC Letter).

[3] *See* note 1, *supra*. *See also* LMCC Letter at 2.

The Commission required that all FCC-certified coordinators reach a consensus on (1) a common analytical method for determining co-channel contour overlap using the values provided in Section 90.35(b)(2)(iii) of the Commission's Rules, and (2) adjacent channel service/interference contour values.[4] On June 26, 2001, the Land Mobile Communications Council (LMCC), which includes all of the FACs as members, reported on the common analytical method for co-channel contour overlap agreed to by all the coordinators.[5] The LMCC also reported on the adjacent channel service/interference contour values agreed to by all the coordinators.[6] Accordingly, we hereby approve and accept the consensus agreement as set forth in the Attachment hereto.

For further information, contact Mr. Tom Eng of the Policy and Rules Branch, Public Safety and Private Wireless Division, Wireless Telecommunications Bureau at (202) 418-0019, TTY (202) 418-7233, teng@fcc.gov.

Action by the Chief, Public Safety and Private Wireless Division, Wireless Telecommunications Bureau.

-FCC-

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[4] Replacement of Part 90 by Part 88 to Revise the Private Land Mobile Radio Services and Modify the Policies Governing Them and Examination of Exclusivity and Frequency Assignment Policies of the Private Land Mobile Services, PR Docket No. 92-235, *Fifth Memorandum Opinion and Order*, 16 FCC Rcd 416 (2000) (*Fifth MO&O*).

[5] LMCC Letter. The letter includes a list of specific frequencies. *See id.*, Attachment A.

[6] *Id.* at 2.

The Frequency Advisory Committees'(FACs) consensus on a common analytical method for determining contour overlap is to be used when coordinating frequencies that, prior to consolidation into the Industrial/Business Pool, were shared by eligibles in following former, industry-specific radio services:

- Power
- Petroleum
- Railroad
- Manufacturers
- Forest Products
- Telephone Maintenance
- Motor Carrier
- Automobile Emergency

For co-channel operations, the consensus values are 37 dBu and 39 dBu for the VHF and UHF service contours (50,50), respectively; and 19 dBu and 21 dBu for the VHF and UHF interference contours (50,10), respectively.

For adjacent channel operations, the consensus relies on a de-rating factor that is applicable when a 12.5 kHz narrowband applicant seeks to use channels offset from wideband incumbents using 25 kHz bandwidth equipment. It is also applicable when a 25 kHz wideband applicant seeks to use channels offset from narrowband incumbents using 12.5 kHz equipment. Note: the consensus is **not** applicable when applicants are seeking adjacent channels offset by 7.5 kHz or 6.25 kHz. The FACs will treat such requests as co-channel operations subject to the contour values noted above.

In the VHF band, for proposed systems offset in frequency by 15 kHz, the de-rating factor is 23.2 dB. The factor is added to the co-channel interference contour value of 19 dBu, producing a 42.2 dBu (50,10) interference contour.

This results in a 37/42.2 dBu overlap criteria. In other words, if the proposed system's 42.2 dBu (50,10) interference contour overlaps an incumbent's 37 dBu (50,50) service contour, concurrence from the incumbent's coordinator, or the incumbent itself, will be sought.

In the UHF band, for proposed systems offset in frequency by 12.5 kHz, the de-rating factor is 12.5 dB. The factor is added to the co-channel interference contour value of 21 dBu, producing a 33.5 dBu (50,10) interference contour.

This results in a 39/33.5 dBu overlap criteria. In other words, if the proposed system's 33.5 dBu (50,10) interference contour overlaps an incumbent's 39 dBu (50,50) service contour, concurrence from the incumbent's coordinator, or the incumbent itself, will be sought.